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ABSTRACT

Strategies to facilitate better cooperation between business and higher education institutions are explored with a focus on policies that colleges, businesses, and public policy makers can implement to utilize educational resources for economic development. Consideration is given to: developing informal university-industry networks, universities as business consultants, university-run industrial extension services, university-industry cooperative research, the state role in promoting innovation, and new business start-ups. For each of these topics, recommendations for university and state officials are offered and examples of activities at a number of colleges and universities are cited. Recommendations for the university include: identify what the university has to offer the private sector; establish business participation criteria that balance business needs and university resources; seek advice from the business community on technical services that they would find valuable; consider personnel exchanges and experimental industry faculty positions; explore the possibility of a center for excellence program; and contribute the college's resources and space to incubator projects. (SW)

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Partners in Growth

Business-Higher Education Development Strategies

Peter H. Doyle
Candice Brisson

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Partners in Growth

Business-Higher Education Development Strategies

Peter H. Doyle
Candice Brisson

Education-Economic Development Series

Northeast-Midwest Institute: The Center for Regional Policy

1985

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David S. Harrison, Executive Director

The Northeast-Midwest Institute is a private, nonprofit organization devoted to research and public education on issues of regional concern. Since the Institute was established in 1977, its primary goal has been to insure that federal policies are geographically equitable and responsive to the needs of the 18-state region that long has formed the nation's industrial heartland. The Institute's primary constituency is policy-makers from the Northeast and Midwest. Business and labor leaders and members of the press from all regions also make extensive use of its work.

The Institute is unique among Washington policy centers because of its close working relationship with the Northeast-Midwest Congressional and Senate Coalitions and its strong ties to state officials in the region. These important constituencies insure that the Institute's agenda addresses the needs of the region and, equally important, that its work will have an effect on national policy.

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Preface

This monograph explores a wide range of strategies to facilitate better cooperation between businesses and institutions of higher education. The primary goal of the study is to identify policies that colleges, businesses, and public policy makers can implement to utilize educational resources for economic development. The discussion is based on the premise that all educational institutions—from community colleges to large universities engaged in leading scientific research—can offer more to the private sector than they do now to improve productivity and competitiveness. It also argues that many benefits will accrue to those institutions that pursue this goal. The development of various initiatives and educational programs, some of which are described in the study, also demonstrate that attitudes in academia toward collaboration with the business community are changing, and that opportunities for mutually beneficial associations are increasing.

The Northeast-Midwest region continues to undergo a fundamental economic transformation. Perhaps no asset of the industrial region is more critical to its revitalization than its public and private educational systems. Yet many of these resources go untapped. This is the first of a six-monograph series designed to promote the construction of stronger bridges between the region's educational resources and the economic development process. Focusing on a single critical issue, each monograph is designed as a tool for policy makers and practitioners to translate available ideas into pragmatic solutions. The series will explore implementation strategies that touch all educational levels, from local K-12 public school systems to higher education.

This six-part education-economic development series is made possible through the generous support of the American Can Company Foundation.

1. Developing Informal University-Industry Networks

The search for better cooperative relationships between business and post-secondary educational institutions has become a dominant theme in contemporary university management. Government officials also have begun to rethink the role of academic research and educational institutions in enhancing technological innovation and business development in the face of sputtering productivity gains and declining national competitiveness in world markets. Policy makers now want and expect to derive economic benefits from government-funded university research and from the collection of talent and resources made possible at these institutions through public funding. Even private institutions increasingly view their own viability and prestige as closely linked with their local economies. Businesses are responding to these changes, sponsoring more research and relying more heavily on post-secondary institutions to meet their training and management-assistance needs. The historic dynamic between academic and entrepreneurial "cultures"—that of adversaries with conflicting ideals, traditions, orientations, goals, and constraints—is giving way to a search for accommodation and collaboration.

Although the adversarial posture is now considered artificial and based on an exaggeration of differences, the perception that industry-higher education relations are weaker than they should be is attributable to a number of factors. Strong anti-business attitudes on many campuses in the 1960s and 1970s discouraged interaction. Even internal university discussions about institutional roles and responsibilities for fostering development in local communities were stifled. Post-World War II federal policy and spending patterns also contributed to the divergence. The rapid growth of federally funded academic research made industry investments in basic research almost irrelevant. To this day, national laboratories and federal mission-oriented research agencies are seen as vehicles to increase the flow of new scientific knowledge and to aid in the development of scientific talent. A few agencies, such as NASA, do show keen interest in new product development. The National Science Foundation (NSF) views basic research as its primary mission, despite some congressional proposals to fund business-university research centers and to create industrial technology centers with its appropriations.

The federal government has a strong role in shaping university research policies. It is the dominant source of university research funds, responsible, in fact, for almost $5 billion of the $7 billion contributed annually by federal, state, and private sources for basic academic research. Consequently, it is not surprising that universities have failed historically to promote the development side of the research and development equation. They, like their

federal funders, have been satisfied with whatever indirect benefits accrued; until recently, few universities have embraced information and technology transfer as a university research responsibility. Tenure and publication requirements, which provide incentives for advances in basic knowledge as judged by one's peers in the scientific community, reinforce the bias against applied research.

Policy makers should confront the issue of linkage strategies directly. High-visibility initiatives such as technology research parks or state-supported centers of excellence often are emphasized. This narrow view overlooks the resources available at institutions that lack nationally recognized research specializations. It also gives short shrift to the learning process in which partners must share to establish a working relationship—one based on a mutual vision and a belief that the effort will benefit both. A key element of this learning process involves resolving the difficult policy questions that arise inevitably from closer relationships with the business community. Another crucial aspect of initial collaborations is the development of strong personal ties that can serve as the foundation for new and more ambitious arrangements.

University officials can promote the kinds of organizational reforms within institutions that encourage communication and problem solving between higher education and industry. Carefully conceived individual faculty initiatives also can strengthen ties. These informal networking strategies require no formal commitments from business. They do, however, facilitate a low- or no-risk opportunity for each side to learn more about the needs, resources, and limitations that the other can bring to more formalized associations. Successful collaborations demonstrate that these partners can create mutually beneficial relationships while fostering greater confidence in the university community and among local business leaders.

Officials should analyze what, if any, types of contact have occurred previously between the two sectors. These contacts should be examined to discover what needs were expressed by businesses, what types of businesses were dealt with, the extent of the contacts, and the results. In addition to the review of past contacts, a survey of current businesses would prove helpful to officials in discerning what types of industry or business should be targeted for informal relations. These may be the businesses concentrated near the university or those needing the most assistance.

University policy makers also should develop an inventory of resources that may be of value to businesses. A frank assessment during the initial stages identifying what an institution has to offer should discourage poor matches that advance neither party's interests and detract from the initiative's overall effectiveness. Not surprisingly, the neediest are usually small and medium-sized businesses that have scant resources. Even though large corporations tend to have strong independent contacts and the resources to obtain any help they need, they still can benefit from association with universities. A business of any size can benefit from the political connections acquired through contact with a public university system,

from closer ties to research efforts with a national scope, and from the opportunity to influence educational programs. Universities can benefit from feedback on the impact of their educational programs. Curricula can become more practically oriented and thus more attractive to students. Business contacts can produce higher rates of employment for graduates. Closer ties can lead to increased business-community participation in fund raising, cultural affairs, and joint community efforts.

Next, officials should consider the nature and extent of contact they wish to have with businesses. It may range from simple faculty and personnel exchanges to directories of university resources for businesses to complete offices for industry relations. These contacts often are intended to involve business persons in the university's affairs and to display the university's assets. Administrators should tailor their outreach plans to facilitate contacts in which university resources best match business needs.

While individual circumstances will shape every relationship, some factors have been found to promote or impede success. First, universities and businesses must acknowledge that both have institutional differences to overcome. These differences are likely to involve management philosophies, research objectives, organizational structures, compensation strategies, and timing. Informal relations built upon incrementally seem to have greater chances of success; they create a sense of trust, which often inspires the level of confidence required to develop more formal and profitable arrangements.

Vital to any relationship is strong and highly visible support from top echelons of the university and industry. This support will facilitate the building of confidence at all levels of business, the university, and the local community. Faculty and businesspersons must open their doors to one another, respect the other's objectives, be flexible in their expectations, and align carefully their strengths and resources with the other's.

At the institutional level, officials have implemented many programs that foster relations between the academic and business communities by encouraging types of cooperation that do not require "formal" business agreements. These programs may identify research endeavors of mutual interest to academia and industry; set up offices matching the needs and capacities of the industrial sector with those of the educational community; develop directories for business and industry that list the specialties of university departments, research centers, counseling facilities, faculty, and classes or seminars that may be of interest to the business community.

Universities across the country have begun to examine the economic environment around them to analyze what their role can be in solving business problems. For example, business students at the **University of South Carolina at Spartanburg** (USC) have surveyed local businesses to determine if the school's business program is meeting their needs. One concern expressed by the Spartanburg business sector was that graduates were not adequately skilled in communications. The university responded by incorporating stronger communications elements in their program. Nevertheless, USC has encountered one

problem common to many schools attempting to foster economic development: the reluctance of the private sector to contribute funds and other resources to the effort. The business community often believes that a public university has the responsibility to carry out any program needed. Yet the costs of these programs often are too high for universities to absorb with no assistance, thus they must look to private and federal sources.

The **University of Illinois at Champaign** has established a business advisory council, composed of senior business executives from the local community, which evaluates components of the university's curriculum. The business program has expanded to include seminars instructing junior and community college professors on how to teach courses in entrepreneurship. The university also conducts seminars for entrepreneurs, funded by a grant from the state. Business advisory councils are a fairly common means of incorporating business opinions into university life. They are usually relatively relaxed arrangements, with meeting schedules ranging from once a month to a couple of times a year. Their advice is reviewed by university officials who adopt viable suggestions.

Beyond the institutional level, some state agencies are coordinating efforts to facilitate university-business communication. For instance, **Minnesota Wellspring** is a joint effort of education, agriculture, government, labor, and business that has sponsored a survey of the state's higher education system and each institution's present and potential relations with businesses. It is funded by both the public and private sectors and is chaired by the governor. Its mission is to build support for business growth and technological innovation. Minnesota Wellspring's technology task force will present its recommendations to the state legislature late in 1985 on capital availability, agriculture, small business, and other economic development topics.

The **University of Michigan** is studying industry-university relations in the state in hopes of determining what types of contact occur between businesses and universities and the ways these ties can be strengthened. The goal is to encourage regional economic development through industrial innovation. Three groups are slated for study: businesses in Michigan; university officials; and university-connected units and programs that promote linkages. Seven basic aspects of university-industry relations will be examined: the nature and extent of current contact; benefits or payoffs for businesses; shortcomings of contacts; how existing contacts developed; impediments to relations; unanswered business needs; and changes in policy by businesses, universities, and government. When complete, this survey will enhance significantly an understanding of business-university interactions. Michigan also is considering a similar study of the Great Lakes states.

The results of building sound relationships between universities and industry are hard to quantify, but their long-term benefits can be well worth the time and effort required for their success. What begins as a simple faculty-personnel exchange between a business and a university may well lead to a successful, profitable research project or consulting relationship further down the road. Involvement of business representatives in university cultural affairs and

curricula may culminate in a corporate-sponsored program. Both universities and businesses are looking for ways to influence economic development positively and to expand their own capabilities and reputations without increasing expenditures. To accomplish these goals, each partner's resources must be exploited efficiently. This task can be accomplished over time by resolving the range of problems that arise in the development of closer ties between very different entities.

Community and junior colleges are at the forefront of the business-education partnership movement. Many have shown tremendous receptivity to assisting businesses and a willingness to respond to particular business problems including employee skills development and degree programs, on-site courses, entrepreneurial training, and financial and management assistance. A later monograph is devoted exclusively to an examination of the community college role.

Recommendations

University officials must:

- demonstrate support for enhanced university-industry linkages;
- analyze past and current university-industry relations;
- identify what the university has to offer the private sector;
- identify what types of businesses require the most help that the university can provide;
- decide on the extent and nature of relations to be provided;
- assess what compromises will be required by both the private sector and the university; and
- obtain high-level business involvement.

8. Universities As Business Consultants

A host of technical and financial problems confront the entrepreneur in moving from idea to prototype to production. Drafting and polishing a business plan, identifying a market, and obtaining first- and second-stage financing can require costly investments in consulting services for companies without significant capitalization or income. Similarly, existing businesses may face major financial, technological, or management difficulties and lack the resources for the kind of high caliber professional consulting services that would enable them to remain competitive and profitable.

Such small businesses often have nowhere to turn for assistance with consulting services but universities. Federal, state, and local governments are beginning to do valuable business assistance roles, but there are still many areas where help is not readily available. States and localities certainly can do more to facilitate the coordinated delivery of all kinds of resources. Individual universities can initiate their own programs to assist businesses. These institutions can function both as brokers of services available from all governmental levels and as providers, drawing on their internal expertise.

Universities offer historically underused faculty and student management and technological expertise. A number of schools have developed mechanisms to match business requirements with their own resources. The experience of these universities can provide leaders that must be considered in setting up and running successful business consulting services in an academic setting. The following is a discussion of goals, policy issues, implementation steps, potential outcomes, and examples of consulting arrangements that policy makers should consider.

It is vitally important to set well-defined goals for a program; they provide benchmarks for measuring a program's effectiveness. The main goals of university business consulting programs are to assist businesses in achieving and applying specialized advice to enhance long term competitiveness, to give students and faculty experience in dealing with real, rather than textbook, problems, and to strengthen trust and respect between the two.

Great potential exists for universities to influence positively the business community. However, the risks are equally great. ***An official involved in developing a consulting program should consider the following:***

- *the state of existing relations between the university and the company or business community;*
- *strengths of the university;*
- *implications of targeting a certain type or size of business;*
- *degree of community support;*
- *provisions for identifying and handling an unproductive relationship;*

- justification of university or [illegible]
- [illegible] of student and faculty time,
- business needs and community [illegible],
- [illegible] between academic goals and activities and the state's current development efforts,
- preference for an active or passive strategy, and
- experiences of universities with similar arrangements.

If both goals and policy decisions have been identified carefully, implementation of a program can be carried out more quickly. The university's strengths play the greatest role in determining what department of the school will house the consulting service. Business, law, or engineering departments most often serve as the consulting base.

The consulting service may be a separate entity from the school. Under this arrangement, it may use all the resources of the university but still retain a degree of independence. However, physical separation may also result in removal from the mainstream of university life and interaction may be more difficult to initiate.

University officials should work with the business community to analyze how consulting services should be provided. Services may be run out of a center with clients coming to the school for help, or through on-site consultations. The nature of business problems and the limit on resources that the university will make available to any single client has a major impact on the selection of consultants. Cases that will extend for long periods should probably have faculty as the main consultants, with new students working on specific subtasks each semester. Other options are for the students to par-[illegible] to work [illegible] in [illegible] consultants with full [illegible] other [illegible] carry on in [illegible], or for faculty and staff to [illegible] with the [illegible]. Students usually receive course credit for their work; faculty and staff sometimes are paid for their time. Whatever the arrangement, care should be taken to retain faculty and students to create according to their ability, interest, experience, and reputation.

A major step in the implementation of a successful consulting program is crafting the agreement between the university and businesses. Each party should lay out clearly what it expects the other party to do, what end products will be produced, and how the consultants will be paid, if at all. Important factors involved in negotiations are that both parties should strive to be as flexible as possible, as open as possible, and patient.

Past experiences with consulting show that financing and timing are the areas most vulnerable to problems. Universities often have difficulty meeting the adequate financing for the consulting services. Funding may be sought from the university, business contributions, chambers of commerce, local, state, and federal programs such as the SBA Small Business Development Center or Small Business Institute programs, or service fees. Arrangements may even be made for the university to receive a portion of cost savings or increased profits. For instance, the University of Alabama at Tuscaloosa has an arrangement with a metals fabricating company in which the firm reimburses the university only for operating costs incurred during the consultation period but the

two share any cost savings or in-

problems may arise and should

were found in less than a year with no disruption of plant operations. [illegible] remained open [illegible] prospects for [illegible]

[illegible] ribute their success to [illegible] munication, mutual respect, strong [illegible] dogged persistence. [illegible] significant problems concerned financing, meeting the degree of [illegible] ed required by GM, and convincing [illegible] g faculty that [illegible] o the university's mission and purpose. Financing barriers were overcome by use of university funds, plus local community support. Both GM officials worked hard at increasing their institutional flexibility and their receptivity to the other's needs and ways of doing things. Faculty support solidified as it became clear that the cooperative arrangement would provide students with an actual laboratory and would strengthen the local economy by saving over 200 jobs.

Both GM and the University of Alabama have benefited from this arrangement in ways that extend far beyond the original project. UA has earned a reputation as an institution that can respond to the realities of the marketplace and deliver services that improve profitability. Increasingly, faculty are involved in consulting for other businesses. GM is working to strengthen its relationships with other universities across the country through a university-affiliate program. GM and UA are also working together on other projects.

The University of Wisconsin at Eau Claire (UW) has combined a great deal of initiative plus funds from the Small Business Administration's Small Business Institute (SBI) to create a comprehensive consulting program. UW uses SBA funds to work with businesses in particular economically depressed communities. Begun in 1983 by Professor Richard Lorentz, this program aims to achieve long-term impact on communities with short-term consulting services.

Teams of seniors or graduate students majoring in business are matched with companies in the targeted area requesting help. The students meet with the client, analyze the problems, and formulate solutions. At the end of the semester, students write up the case and present it to the client and the SBA. If the work is satisfactory to everyone, the school is reimbursed $400 for each case by the SBI (the standard rate) and the students receive course credit.

Covering costs and making sure that students complete their cases were the two biggest problems the program encountered. The university is considering charging the communities a small amount for the consulting work to supplement case fees. Faculty now monitor student time as closely as possible to prevent overloads.

Over 500 universities now participate in the SBI program, an annual $3-million line item in the annual SBA budget. Most SBI programs use their funding to provide short-term consulting services for small businesses that, with the support of their communities, request help.

UW adapted its program from the usual SBI arrangement in order to concentrate on overall community economic patterns rather than scattered individual business problems. In addition to working with individual firms, the university pools the SBA case funds to conduct a broad economic survey of targeted communities, analyzing businesses' needs and the

number and types of businesses the area can support.

It is too soon to judge the program's effectiveness. But communities that have received consultations believe they have developed a stronger business environment. The short-term nature of the SBI-funded work does not allow the university to incorporate mechanisms to ensure continuing feedback from all clients. This weakens UW's ability to maintain relationships with these localities and to assess its program. However, because of budget limitations, follow-up consulting is not an option for SBI-funded efforts. UW is looking to other federal funding sources, such as the Economic Development Administration (EDA), for support in longer-term business consulting.

UW's program shows the positive effects of a federal role in facilitating university-business consulting programs. The SBA's Small Business Development Center (SBDC), program is another kind of federal support of business outreach effort. SBDCs provide business consulting services through a cooperative agreement between the federal government and a state-wide network set up within a university system. The SBA provides half the funding and the other half is arranged by a lead organization—a government unit, a university, or a private concern. Funds are distributed according to a formula based on the population served by the SBDC or $200,000, whichever is greater. The program began in 1980 and is authorized through 1988. Thirty-five states participate in the program and all but two of the rest have shown interest in doing so. Its 1985 federal appropriation is $28 million. The SBA anticipates that most states will eventually join.

To be eligible for SBA funding, SBDCs must meet several requirements. There must be a designated lead organization responsible for securing matching funds, setting up the actual center, running the program, and reporting to the SBA. Each program must have a full-time state director and facilities must be located to serve the entire state equally. The center must be open 40 hours per week and provide both short- and long-term assistance. The governor must give written approval for a program to assure the state's endorsement and increased stature.

State policy makers should support the creation or expansion of a small business development center system. A number of state actions are instrumental in leveraging federal SBDC resources: the designation of a lead institution, the appropriation of funds to cover the salary of a director and administrative costs, and creation of a system to facilitate nonfederal financial matches. Illinois currently is the only state to designate a state agency, the Department of Commerce and Community Affairs (DCCA), as the lead SBDC organization. DCCA and the six university subcenters form a unique partnership between the state and the academic community. Consequently, the SBDC network is well integrated into the state's development plans and has the advantage of direct access to university and governmental resources.

SBDC goals are to offer consulting and general management analysis to small enterprises that cannot afford private consulting services. The services are free to eligible businesses and are normally provided by graduate or senior students and faculty. While the SBDC goals are basically the

same as those of the SBI program, its services are more comprehensive. If structured properly, an SBDC program can link the resources of universities throughout the state with participating businesses, rather than just one business department in a university.

SBDCs frequently encounter problems in selecting the lead organization and in arranging financing. In some cases the choice of the lead institution has become highly politicized, suggesting that SBDC participants should set out goals and requirements to ensure a degree of objectivity in the selection process. Most SBDC lead organizations are universities, but several interested Midwestern states are leaning toward the Illinois model of choosing a state agency as the lead organization. This approach offers the advantage of state support.

The diversity among SBDCs reflects the degree of program flexibility available. For example, Oregon opted to set up its SBDC network through the state's community college system. State officials reasoned that community colleges are closer to small businesses and offer fewer barriers to cooperation.

Pennsylvania's SBDC network is coordinated through the University of Pennsylvania's Wharton School of Business, with subcenters throughout the state. This program's early success can be attributed to its close ties with the Ben Franklin Partnership discussed in Chapter 5. In fact, the four universities that house the partnership's four advanced technology centers also house SBDCs. The result is that the SBDCs enjoy strong state support and are an integral part of Pennsylvania's overall economic development efforts.

Clearly, state governments have tremendous potential to develop state-wide higher education networks to provide consulting services to businesses and industries. Many programs are too young to be judged, but their comprehensive approach is assuredly a step in the right direction. The federal support that supplements these programs should be continued and strengthened in order to assist states in strengthening their own economies.

Recommendations

University officials should:

- articulate a policy clearly supporting greater business-university interaction and identify institutional policies, such as tenure guidelines, that discourage business outreach efforts by professors and departments;
- establish business participation criteria that balance business needs and university resources;
- establish business consulting program goals;
- identify sources of funds for the program;
- devise a system to choose faculty and students for consulting;
- develop a system of fees and compensation; and
- establish mechanisms to resolve problems relating to enhanced business contact.

State policy makers should:

- identify state economic development policy priorities;
- establish state university policies and appropriate funds to utilize state university resources to achieve policy goals;
- review state-mandated university structures and policies to determine whether they encourage business-university collaborations;
- require state-supported universities to assess the feasibility of establishing a Small Business Institute program, and require creation where feasible;
- support the creation or expansion of a state-wide small business development center system through such actions as legislatively endorsing a lead organization, creating mechanisms that simplify nonfederal matching requirements, and appropriating funds for a state director's salary and center facilities; and
- review an existing SBDC network to ensure that it is well integrated in the state's development philosophy and goals.

3. University-Run Industrial Extension Services

Many manufacturing firms and most small businesses have negligible or nonexistent research budgets. In addition to considerations of expense and economy of scale, the lack of contact with and physical separation from university technology-development programs inhibit the transfer of technology to these businesses.

Industrial extension services operating from public university settings help to lower barriers to technology transfer and application. Based on the agricultural extension service model, industrial programs respond to individual business problems and promote new technology for businesses. In a departure from most agricultural programs, university staff generally emphasize technology transfer rather than new research advances. This approach may concentrate on established firms with growth potential or needy firms.

State governments are key players in creating or increasing industrial extension service programs. **Initially, policy makers must define carefully state economic development goals and match them with resources available at the state's technically oriented universities.** Goals can include identifying target industries that are or have the potential to become important producers of jobs and revenue in the state.

Legislators must identify funding sources or appropriate new monies for extension services. Such expenditures will provide not only direct benefits to businesses but also promote the better utilization of the state's educational resources for economic development. University-based extension services reach out to businesses to increase their access to technology and information by opening university resources to the private sector. This knowledge and technology diffusion can solve business problems, increase productivity, and strengthen university-industry links. Closer ties also will enable universities to identify research problems relevant to businesses, and provide universities with direct feedback on research applicability.

Governmental and university policy makers must confront a number of important design issues. Industrial extension services usually are based at technically oriented universities that can provide both technical and management assistance. The extension agents may be faculty working directly out of departments or may be affiliated with free-standing offices that use faculty and students for consulting. The agents may offer technical and management assistance, or simply the former. Services may be provided to clients for a nominal fee or free of charge. Operating funds for the services may come from the state, the university, or research contract fees.

In setting up extension services, state policy makers must consider carefully whether to establish field offices. Typically extension services are pro-

vided anywhere within state boundaries. Some programs choose to have only one main office because it simplifies operations and limits costs. However, this option also may limit the contact and service provided to outlying regions. Programs with field offices may offer service continuity while facilitating long-term contacts.

Industrial extension programs adopt either a passive or aggressive approach to service provision. More passive programs often operate as clearinghouses for information and as referral mechanisms to other agencies. Typically, services are provided in response to client requests for information or help. They are less expensive to carry out, but perhaps less effective. **Implementation of an aggressive model requires policy makers to seek out target industries that could benefit from the exposure to emerging technologies.**

As with any program, limited funding has hampered extension services. Agricultural extension programs had less difficulty because they offered one cohesive voice that elicited tremendous support. The mix of industries involved in industrial extension services often does not have the same cohesiveness and does not benefit from the same broad political support enjoyed by the agricultural community, although the economic impact may be as great. One shortcoming of industrial extension services is that they cover a broad range of industries and consequently may not be equipped to deal with in-depth technical problems. Businesses requiring this type of assistance are usually referred to another agency or consultant.

State legislators and university officials who are aware that numerous positive impacts may come from university-based extension services are critical in nurturing the political support necessary to sustain these programs. Potential benefits are great. For example, communities come to depend on the assistance and information provided by the university; the links formed by the extension program may lead to economic growth beyond the original arrangement; and initial favorable extension contacts may promote participation in continuing education classes held throughout the state. Universities also may develop more specific extension programs, such as those described below, in such specialties as energy conservation, environmental health and safety, and productivity.

The **Georgia Institute of Technology Industrial Extension Division** strives to address specific problems of small manufacturing firms by assisting with innovative technology transfer and traditional technology and by sponsoring research. Based in Georgia Tech's Engineering Experiment Laboratory, the division has 12 field offices, each with one or two engineers. Each year more than 600 companies without the financial resources for private consulting turn to an extension office for help, which can range from a simple information request to five days of on-site technical assistance. Businesses requiring more than five days of help are referred to another office or agency.

Georgia's extension service was established in 1962 by the state, from which it still receives half of its funding. The rest comes from research contracts in which the extension center will consult on specific problems for a paying

client. The program is well established at this point, depending mainly on its reputation to draw clients. Division officials feel that strong state support and cooperation between the university and the state give the extension division credibility with the private sector.

While the Georgia Tech Industrial Extension Division is based at a university, it uses mainly full-time employees as extension agents rather than faculty members. Few students work with the program and faculty are seldom brought in as paid consultants. This arrangement may limit the degree to which overall university resources are used. In Georgia Tech's case, the university appears to serve primarily as a base for the center.

North Carolina State University Industrial Extension Service was created in 1956 by the North Carolina legislature. This service is more closely integrated into the university than is Georgia Tech's program. Faculty serve as extension agents, along with some full-time agents; there are no field offices. Four regional offices maintained previously were eliminated in the expectation that contacts could be continued without them. As a result, extension agents find themselves continually struggling to update and maintain industrial contacts, according to an extension official.

The majority of North Carolina State's extension efforts are spent in referring business problems to appropriate state agencies or even to individual faculty who do private consulting. Extension agents only deal with problems that require less than one day's work. These services are provided free if the business has shown that it can not afford private consulting.

The program emphasizes the integration of computers into manufacturing and factory expansion and design needs. In this approach, extension agents mainly serve firms that are stable enough to take the risks associated with technological innovation. This eliminates needier, cash-poor businesses, which are referred to state agencies for assistance.

State roles in industrial extension services have been strong in the past and show every indication of continuing to be so. State participation is reflected by support from state legislatures and cooperation between state agencies and extension offices. For example, Michigan is developing a **Manufacturing Extension Service** to bridge the gap between university research and small- and medium-sized businesses. The service proposes to solve production problems of businesses with scant ability to undertake research or apply innovative ideas.

The idea originated in a task force commissioned by former Michigan state commerce director Ralph Gerson. In its far-reaching 1984 study, *The Path to Prosperity*, the task force concluded that the state, as part of its economic strategy, should move innovation into existing small- and medium-sized firms on a continuing and systematic basis. It called on the state to establish a manufacturing extension service to strengthen its comparative advantage in industrial technology. Governor James J. Blanchard endorsed this strategy in his 1985 State of the State message.

Like the programs of other states, Michigan's extension service will take advantage of its universities and community colleges. In contrast to others, the service will target specific industries, such as auto supply firms, that

make up much of the state's critical base of small manufacturers. When implemented, the program will bring Michigan manufacturers in contact with university-based technology experts who can provide state-of-the-art consultations.

Financial support of industrial extension services from the federal government has been minimal and sporadic. According to the terms of the Morrill Act of 1862, land grant colleges were intended to tie higher education to the industrial economic sector. This act established both agricultural and engineering extension services, but the latter never succeeded in the manner of agricultural programs. By the late 1930s, almost 40 state- and university-sponsored engineering experiment stations had been set up without assistance from the federal government. From 1965 to 1968, the State Technical Services program provided a total of $20 million for all 50 states to promote economic growth through industrial modernization. Critics deemed the program a failure after only three years, but some sources, such as the General Accounting Office, concluded that this was not sufficient time to establish stable extension programs and produce concrete results.

Currently, extension services are supported by the federal government through various economic development programs. These include the SBDC and SBI programs, the Economic Development Administration technical assistance services, and the Occupational Safety and Health Administration programs that identify and solve environmental health and safety problems of businesses. More specific information on federal funding can be obtained from these agencies' regional or central offices.

Recommendations

University officials should:

- educate policy makers and the general public about university resources that could promote development;
- help design an extension service system that complements program strengths, administrative structures, and geographic locations;
- seek advice from the business community on technical services that they would find valuable;
- assist legislators to develop policies concerning the selection of extension agents, their relationship to university faculty, the location of offices and the scope of offered services; and
- promote the program based on its value to the university and the business community.

State government officials should:

- identify state program goals, such as aiding critical target industries and improving economic opportunities in distressed areas;
- match these tools with existing university resources;
- develop policies on selection of extension agents, the location of offices and the scope of services provided;
- appropriate funds sufficient to meet mandated program goals; and
- develop referral mechanisms to other state agencies.

4. University-Industry Cooperative Research

Industry sponsorship of academic research is on the increase, and now accounts for more than 5 percent of total university research budgets. Total federal support for research and development grew 56 percent between fiscal 1981 and 1984, but did not result in significant increases for the biological, engineering, or physical sciences. Virtually the entire growth in the R&D budget has been targeted on military research, and particularly weapons technology development.

University administrators increasingly perceive business as a source of funds to offset static or shrinking federal grants and contracts, and view the establishment of one-to-one university-industry research relationships as an important way to achieve this goal. **For university-industry projects to run smoothly, all parties must acknowledge the goals and benefits of enhanced relations as well as the potential problems.** This kind of cooperation raises a host of ethical and legal issues that must be confronted as a precondition to university participation in collaborative arrangements. These issues can be especially difficult for public universities, which are chartered with broad service missions and operate with public funding. **Successful collaboration also requires the development of guidelines in cooperation with potential business partners to ensure that policies are mutually acceptable.**

Business expects a quid for its quo. Businesspersons expect to influence the course of sponsored research and feel that they have bought ownership rights to the fruits of the collaboration. Understandably, private-sector investors insist that universities establish procedures to protect proprietary information. University research, in contrast, is founded on the free flow of information. The "right to publish" is frequently a mandate to publish, and publish first, in order to gain stature and security in the university community. Open disclosure policies are particularly defensible when years of prior government support has made possible commercially valuable research. An agreement must accommodate the divergent interests of each partner. Restrictions on foreign corporation sponsorship may be necessary. **Obviously, universities must develop patent and licensing policies before entering into collaborations.**

Universities should develop conflict-of-interest policies for business-sponsored research. A university may want to restrict its scientists from holding equity positions or serving as officers in companies from whom they also receive research funds. It also must ensure that graduate student research is guided by the principles of open scholarly inquiry and that the system develops skilled scientists. Some institutions simply restrict graduate students from projects that have strong commercial potential to avoid conflicts that could inhibit

corporate sponsorships or harm students' professional reputations.

University officials must consider the fact that corporate research sponsorship may also affect the direction of research within the university. The choice of topics and the balance between basic and applied research could change as a consequence of private-sector funding. The university must have a clear grasp on these academic freedom issues.

The record of the past few years demonstrates that these issues can be resolved and successful alliances forged. While collaborative efforts have not always matched some observers' expectations, the number of abuses and ill-advised associations also has been small.

In 1981 the U.S. House of Representatives Committee on Science and Technology requested that the American Association of Universities (AAU) develop guidelines to govern university-industry associations. A Committee on university-industry relations was created. Recognizing the uniqueness of these arrangements, the committee concluded that a clearinghouse on university-industry relations would best meet the needs of the public. The Clearinghouse makes available information on specific collaborations and operates from the AAU offices in Washington, D.C.

In addition to these difficult policy issues, universities must confront the major "cultural" differences that divide the academic and corporate research enterprises. Research collaboration start-up hurdles are similar to those faced by schools that desire informal relations, as described in Chapter 1, but the scope of the endeavor magnifies these difficulties. Extensive prior interaction between businesses and universities is the soundest foundation on which to establish ambitious long-term arrangements. Each partner must acquire confidence in the other's talents and an appreciation of the other's operations and limitations. At the outset many industry researchers question the ability of academia to perform industrially sponsored research effectively. The challenge is to devise coupling mechanisms to strengthen communication and understanding between academic and business communities.

The dimensions of this gap should not be underemphasized. Many universities lack a basic understanding of marketplace demands. **University administrators must learn and convey to their research faculty the particular needs, goals, and limitations of their potential corporate partners. They also must educate themselves on the very different ways that federal agencies and corporations budget and operate external research programs.** They must develop outreach programs, identifying companies whose interests are coextensive with university research strengths. **Perhaps most importantly, scientists must expand the traditional reward system based on peer review and contribution in one's field to one that values corporate resource efficiency and commercial success.** University administrators are critical facilitators of this transition. **They must rethink and restructure academic incentives to promote commercially relevant research.**

A number of universities have promoted greater business-university interaction by compiling directories or establishing on-line data bases that provide detailed information on resources. The

University of Wisconsin system and the state's county extension offices have produced a directory that lists department and research center specialties, small business development centers and outreach offices. In Illinois, **Faculty Research Assistance to the State** (FRATS) provides business with a computerized information file on faculty research interests.

University-industry affiliate and technology-transfer programs are two models of industry-university interaction that bring a university and the local business community together to exchange information, increase personal contacts, and speed the technology innovation process. They provide opportunities over time to reduce these "cultural" impediments to collaboration.

University-industry affiliate programs provide industry with timely and efficient access to research expertise in exchange for annual participation fees. Members usually receive consultation rights, access to formal conferences, and notice of planned research activities. This interaction can attune universities to industry research needs. **University officials should use these programs to show that their institutions possess the personnel and equipment to commercialize products and meet other specific research needs more quickly and efficiently than the business partner.** Conversely, business collaborations will help universities identify personnel and equipment investments necessary to develop a technological niche to meet local industry needs. Affiliate programs can generate substantial revenues.

Scores of industrial affiliate programs now operate throughout the country. **MIT's Industrial Liaison Program** has approximately 300 member companies and an operating budget in excess of $300 million. Stanford University has created 21 decentralized affiliate programs that provide a broad spectrum of services and levels of participation under a flexible member fee system.

Smaller universities have established successful programs as well. The **Center for Composite Materials** at the University of Delaware has begun its tenth year of operation and boasts over 30 domestic and international industrial sponsors. It recently held an international conference attended by over 500 scientists. The center provides internships for industrial researchers and promotes technology transfer through its reports, papers, newsletters, and technical compendia.

Also at the University of Delaware, the **Center for Catalytic Science and Technology** supplements its funding through grants and contracts from both federal and industrial sponsors. Projects sponsored by individual corporations are also undertaken at the center.

Technology-transfer programs promote the commercialization to industry of new discoveries. These services are generally supported by the collection of royalties. Some universities have established internal offices while others use external entities legally distinct from the university.

The **Wisconsin Alumni Research Foundation** (WARF) is the oldest and perhaps best known external technology-transfer program. WARF licenses patents derived from university research, redirects most of the royalties back to the university to fund new scientific investigation, and retains a small portion to

support its operations. Inventors whose work is supported by WARF funding are not required to assign their work to the foundation. However, voluntary assignment entitles them to receive 15 percent of net royalties and the corporation's services for securing patents and licensing arrangements. Similar foundations are affiliated with Cornell University, the University of Maryland, the University of Michigan, the University of Minnesota, and the University of Utah.

Universities that use external offices, which are sometimes established as for-profit entities, should consider carefully whether the office's reward structure coincides with the institution's long-term faculty, research, industrial sponsorship, and revenue goals.

The **Stanford University Office of Technology Licensing** is an example of an internal office that also operates on a royalty-sharing arrangement: the office takes 15 percent of the royalty revenues with the remainder split equally among the university, the department, and the faculty inventor.

These offices provide valuable patent protection and licensing assistance. Securing world-wide patents involves strict application procedures; the process can take two years and costs can exceed $100,000. It is difficult to find investors to underwrite this process and often it may take years to see returns from time to time. A potential investor can be hard to convince a positive return on only one out of 60 or 70 research ideas. Entities such as WARF are able to identify innovations more efficiently. They provide individual and institutional incentives for technology transfer while positioning local businesses to identify crucial faculty expertise. The state and region benefit as the likely locus of innovation-based economic growth.

Linkage strategies were first viewed as an industrial recruitment tool, essentially as a strategy to redistribute the national economic pie. However, the success of technology transfer programs and other university efforts to foster innovation and growth have led many states to adopt linkage strategies as a way to help their own companies. Many of these models are centered on the university.

The **Wisconsin Alumni Research Foundation** produced a dramatic jump in the number of invention disclosures and more than doubled patent application filings in its first year of operation. Technology-driven development takes many elements, but most fundamentally it requires ideas with commercial potential. The success of innovation-transfer mechanisms shows that these ideas are abundant and argues for strong federal and state support of these efforts.

Another traditional mechanism to promote closer ties is **sponsored-program offices**, which can operate either at the department or university-wide level. These are particularly appropriate for large research universities. Typical functions include: promotion of research programs; identification of programs for potential collaboration; and negotiation of contracts and conditions. A primary function of these offices is to ensure that those pursuing an industry liaison understand the rules through which business contacts can be established.

Although economists estimate that 40 to 60 percent of economic growth can be attributed to technological advances or increases in knowledge, the United States has

no coordinated program, at the federal level or elsewhere, to channel innovation to the marketplace. Prospects for federal leadership in this area appear slim. Civilian applied research spending has failed to keep pace with inflation during the past few years. This reflects the administration's policy, only slightly modified by Congress, not to support applied research with any promise that for private proprietary, that goal, Congress passed the Stevenson-Wydler Technology Innovation and Manufacturing Competition and Industrial Research and Development Act of 1984 to improve the development and transfer of manufacturing technology. President Reagan vetoed the legislation on the grounds that it represented an unwarranted intrusion into private-sector decision making. Therefore, the future burden to develop technology transfer mechanisms will rest increasingly on universities and on state and local governments to promote and support.

Recommendations

University officials should:

- clearly articulate the goal of enhanced relations and develop specific faculty personnel and administrative policies to promote closer cooperations with businesses.
- establish policies on academic freedom, conflicts of interest, etc.;
- identify impediments to commercialization including patent policies, licensing restrictions;
- consider personnel exchanges and experimental industry faculty positions; and
- establish mechanisms to facilitate invention patenting.

State policy makers should:

- create university-wide data bases that identify current research and faculty expertise;
- identify institutional strengths matching state development goals;
- review state university patent policies and personnel policies; and
- facilitate greater resources coordination among state system schools on business collaborations.

5. The State Role in Promoting Innovation

Many states are moving quickly into the high and advanced technology economic development area. Governors from states with little experience in economic development have been joined by governors who have had the advantage of high tax revenues and considerable funding to begin projects aimed at capturing high tech growth.

States that seek to develop ambitious programs without a solid record of industry-university achievements move forward at their peril. Universities hoping to collaborate successfully with industry must have well-defined institutional policies on shared research, a record of successful short-term applied research problem-solving, patent policies that encourage innovation, and the proven capacity to coordinate research with other institutions. Two basic theses of this discussion cannot be ignored: first, the individual circumstances and peculiarities of both a university and a business affect fundamentally the evolution of their partnership. Second, this shared learning process is a prerequisite to forge those effects which inevitably generate complex problems.

The New York State Science and Technology Foundation has relied heavily on institutions that have successful relations with business in designating seven public and private university-based advanced technology centers. Following their selection, all the centers have adopted policies to promote increased private-sector involvement. The State University of New York at Stony Brook has already attracted more than [illegible] in corporate support [illegible] and has developed a reputation for working with local industry.

Innovation based development has attracted the attention of federal and state policy makers. In 1980 Congress passed legislation creating Engineering Research Centers as part of the Stevenson-Wydler Act. However, since that time federal action has slowed. Congress has not provided funds for the Stevenson-Wydler industrial technology centers and, as mentioned, the president vetoed the Manufacturing Sciences and Robotics Research Act of 1984 (MSRRA) designed to help improve and disseminate manufacturing technology. The administration maintains that American industry has responsibility for commercializing technologies and that the MSRRA represented an unwarranted intrusion into the private sector.

State policy makers have found [illegible] the potential for innovation driven development and significant state action has resulted during the past five years. A [illegible] has involved both the attraction of high technology businesses and the development of new and expansion of existing firms through improved technology transfer systems. At the end of 1984, 34 states had established state chartered programs dedicated to high

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business incubation. **Policy makers should consider linking these efforts to state-aided university-business cooperative research programs to leverage fully federal technical-assistance funding.** This kind of structure is well suited to generate the nonfederal match required for the Small Business Development Center program (see the discussion in Chapter 2). In addition, state participation in cooperative technical assistance programs will aid entrepreneurs and inventors who are seeking assistance through the SBA's Small Business Innovation Research (SBIR) program. SBIR requires each federal agency with more than $1 million in year in outside research and development contracts to small businesses. The SBA reviews the agencies' programs and reports to Congress. Between 1983 and 1985, appropriations increased from $110 million to $810 million. Federal agencies received 7,800 proposals last year and made 958 awards. SBIR has three phases of contracting for small businesses:

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project feasibility, product or technology development, and commercialization. This program is relatively young but has received good response from the private sector, perhaps because it requires no private financing. SBIR was established on the principle that small businesses produce two and one-half times as many technological innovations as large firms, but were not obtaining a fair share of grants under the previous allocation system.

Despite the popularity of university-based and university-connected research centers and the high visibility afforded them by governors and other state leaders, there is little conclusive evidence of the extent to which these centers are cost-effective economic development tools. Some anecdotal information, however, is highly persuasive.

State cooperative research centers should be evaluated closely to identify those factors most necessary for their success. The federal government is the obvious choice to undertake this review, to provide assistance to programs that have potential, and to aid new programs in formation. The National Science Foundation has gained considerable experience in these areas during the past decade through the operation of the Industry-University Cooperative Research Centers Program (IUCRC). One-year planning grants and five-year cost-sharing grants are available to sustain centers during their early operations. Only one of the three initial centers, MIT's Polymer Processing Center, still exists. However, ten newer centers are operational and another four are in the transition from planning to operations. Some centers, such as the Ohio State University Center for Welding Research, Case Western Re-

serve University's Center for Applied Polymer Research, and Rensselaer Polytechnic Institute's Center for Interactive Computer Graphics have received solid support from both the business and academic communities, and show good prospects for long-term self-financed operations.

State and city policy makers have recognized more quickly than university administrators that systems of higher education are critical resources for development. **Government officials increasingly view educational funding as an investment that should show a return in heightened local business productivity, satisfy labor force requirements, and bring new business start-ups.**

The establishment of cooperative research centers also parallels recent trends of business support for university research. Increasingly, businesses fund broad areas of academic research rather than targeting specific, short-term industry needs. A number of recent biotechnology agreements follow this pattern of multi-year funding with projects focused on both basic and applied research issues.

State government and university policy makers who wish to pursue high- or advanced-technology strategies should make a frank assessment of higher educational resources, the needs of the indigenous industrial base, and political support for a sustained effort. Careful program definition is imperative. They must decide if the development of commercial technologies is secondary to ensuring that the state captures any development derived from the research cooperative through, for example, restrictive patent licensing arrangements. The focus of the center may be channeled into either a broad or narrow area—"niche filling." This latter strategy has been adopted by the **University of Kansas** to exploit its expertise in biotechnology subspecialties. A state may want a more broad-based approach, such as **Arizona State University's** Center for Excellence in Engineering, an ambitious five-year, $50-million project. These centers might serve primarily as business recruitment tools or concentrate on the development of new technologies for existing businesses. New business start-up also might be a major focus. **State policy makers must determine how closely to tie a center to its sponsor institution.** The **New York State Centers for Advanced Technologies** discussed earlier in the chapter are university-based, operating as arms of the participating schools. This arrangement ensures close faculty cooperation and departmental involvement. Other centers, such as the **Michigan Biotechnology Institute** and the **Industrial Technology Institute**, operate more autonomously. Officials at these institutes believe that a looser university connection increases their flexibility to meet industry research needs and helps their institutes set themselves apart from the university, which a number of potential clients perceive as holding an anti-business bias. The resolution of these issues have clear implications for program design and evaluation.

Some question the capacity of a university or state government to measure the comparative stature of its university departments and leading faculty in the high-technology fields. The dominance of federal funding in academic research and the heavy skewing of

federal contracts and grants to a small percentage of institutions underscore the importance of careful definition in areas of comparative excellence. There is a fast-track competition among a small, elite group of players, and even universities with national stature are not always successful in garnering significant federal funding. State backing of research enterprises that do not receive federal funds represents a major gamble of state resources.

The recent success of Texas in convincing the Microelectronics and Computer Technology Corporation (MCC) to locate near the University of Texas at Austin shows the importance of strong and visible political support. The university has been unflinching in its efforts to recruit a top-notch electrical engineering faculty and research program. Leaders in other states must realize that their efforts will not be self-sustaining from the start and commit themselves to the long-term process.

One key measure of excellence is industry support. **State and academic planners must cultivate industry participation.** Business membership reflects the private-sector judgment that a cooperative research arrangement purchases more than could be accomplished in-house. Strong industry involvement at early stages will ensure that a center's goals and structure are responsive to industry needs. It also will improve prospects for long-term industry support. Ultimately businesses will choose to remain members because of the quality of research output, the degree to which this output meets expectations, and the degree to which proprietary interests of the various industrial sponsors can be reconciled. **Unless policy makers and universities make businesses full partners in the development and operation of the center, the likelihood of failure is great.**

Pennsylvania's **Ben Franklin Partnership Program** (BFP) and Ohio's similar **Thomas Alva Edison Partnership** (TAEP) are two of the more ambitious and comprehensive state-supported efforts to spur business-industry collaborative research. In the late 1970s, a number of Pennsylvanians recognized that a new response was needed to compensate for the decline in the steel industry. Industrial recruitment had not been particularly successful in the state. Surveys identified some important research strengths, but also poor business-university relations that were hindering high-tech development.

BFP features a decentralized approach that relies on local initiative to identify critical technologies. The central component of the BFP program is the distribution of challenge grants to four regional Advanced Technology Centers (ATCs) located throughout the state. These grants are matched with outside funds, preferably from businesses. To foster an entrepreneurial spirit, the ATCs compete among themselves for yearly funding. The state's $18 million appropriation has been matched with $56 million from program participants. This approach is intended to complement and build on the strong base of industry and academic research already present in the state. In contrast to the BFP centers, which sponsor research in a variety of fields, TAEP has devised limited research agendas that reflect the expertise and interests of local business and nearby universities. As a result, the manufacturing center is located at the University

of Cincinnati; all polymer research is undertaken at Case Western Reserve and the University of Akron; and welding work is undertaken at Ohio State.

A key achievement of the Ben Franklin Partnership has been the development of strong relationships among ATC consortia which include public and private academic institutions, business and industry, organized labor, economic development organizations, and private investors. The partnership has increased interuniversity cooperation, for example, between Carnegie-Mellon University and the University of Pittsburgh.

The BFP has three goals: to maintain and create jobs in new advanced-technology enterprises, to improve productivity, especially among the state's existing businesses, and to diversify the state's economy. To ensure that development activities are retained by the state, restrictive patent policies are applied. Any new patent or technology produced through BFP-sponsored research must be commercially exploited by in-state manufacturers or the state funds must be fully repaid. The BFP or university retains patent ownership and may grant exclusive licenses. However, if the sponsoring firm does not exercise its license rights, an assignment protocol which includes state small businesses must be followed.

The legality and effectiveness of this patent policy is not yet clear, but it rigidity may inhibit research. **State policy makers must review these issues in advance.** A more flexible approach, based on a good-faith understanding with industrial sponsors to exploit patents within the state if feasible, may prove as effective and significantly more attractive to private-sector investors. So far, the impact on the state's economy has been modest. Yet the BFP has established a procedure to draw on the state's resources in a more effective way. Its continued success rests in part on the sophistication of the university in responding to industry needs based on the kinds of interactions already described.

The BFP and TAEP examples show that participating universities should have preexisting and sound relationships with business. They should have policies on shared research, a record of successful short-term applied problem-solving, patent policies which encourage innovation and the proven capacity to coordinate research with other institutions.

Recommendations

State policy makers and university officials should:

- create jointly supported business-university partnerships to exploit fully programs such as SBDC and SBIR;
- explore the possibility of a "center for excellence" program founded on a state's comparative advantage as a place to operate certain types of business and undertake related research;
- plan the research center carefully to ensure adequate resources and political support to sustain the effort;
- set measurable goals for centers for excellence;
- promote private-sector participation in state advanced- or high-technology programs;
- review state patent and licensing policies for state-funded innovations;
- emphasize comparative-advantage strategies in promoting existing business; and
- coordinate manpower and high-technology policies.

6. New Business Start-ups: Stimulating Incubators and Beyond

Although economists continue to debate the degree to which job creation is derived from new business creation and expansion, it seems clear that this is a significant component of economic growth nationwide. About 8,400 new corporations are started each year, but only one-third will survive the first four years. New business start-ups are a primary goal of many of the programs in this discussion. Incubators and innovation centers are important components in reducing the formidable barriers that inhibit new firm birth and long-term business viability.

State policy makers should consider making available state funds to support the creation or expansion of incubators. States are involved extensively in the development of small-business incubators. Pennsylvania, with 16, is the preeminent state incubator operator. The Ben Franklin Partnership, the commonwealth's most visible program, coordinates resources among universities, development organizations, financial institutions, and education groups through four regional centers. (See previous chapter for details of the partnership.) Pennsylvania also uses funds from the Appalachian Regional Commission, the Pennsylvania Industrial Development Authority, and the U.S. Department of Housing and Urban Development's Small Communities program to support incubators. Most but not all incubators have ties to at least one educational institution.

Although many incubators operate independently of university ties, there are clear advantages to this kind of arrangement. These firms are in much better positions to take advantage of technology-related university research, to tie into university resource networks, and to benefit from the university's stature in the community. On the other hand, university incubators tend to be more bureaucratic and more heavily dependent on in-house services than independent entities. It is sometimes difficult to circumvent technical or managerial shortcomings in the university community. Several large and growing incubators are now in operation, including Science Park in New Haven, cofounded by Yale University, the Olin Corporation, and the city, and the University City Science Center, a multi-university consortium at the site of the Ben Franklin Partnership's regional advanced technology center in Philadelphia.

University officials should identify financial and service resources as well as space that the university could contribute to an incubator facility. Start-up costs for some incubators have come from university endowments. Empty or underutilized university facilities provide an obvious home for incubators; some institutions also have made space available at low or no cost. Some universities absorb utilities and building maintenance costs and subsidize consulting services by

university faculty and staff.

University administrators and state and local officials are motivated by more than improving the economic health of their communities. Some institutions have established incubators as a way of strengthening graduate programs, attracting nationally recognized faculty, and creating consulting opportunities for faculty and students. Rensselaer Polytechnic Institute (RPI), set up an incubator and a research park to promote its reputation. RPI views its own success over the long term as linked inextricably to the success of its sponsoring of research-based development in the area.

University incubators may offer a great range of services to new businesses. Typically, services are provided and billed on an as-used basis. Rent may be subsidized, and space tailored to firm needs. The incubator may assist in the preparation of business plans, in making contact with the venture capital network, and may even take equity positions in some firms. Incubators have synergistic benefits as well: the concentration of new companies can increase individual firm visibility, ease access to venture capital, and provide a mechanism for the exchange of information among business founders.

In 1982, Ohio University created the **Innovation Center and Research Park** to promote economic growth in southeastern Ohio and to expand student and faculty experience with industry and small business. Located in the depressed foothills of Appalachia, Athens, Ohio, has no industrial base. A university study concluded that coal mining, subsistence farming, a few medium-sized businesses, and the university formed the region's economic core. In response to this study, Ohio University's president Charles Ping committed its resources to revitalize the region. Initial funding of $50,000 was contributed by the Ohio University Fund, Inc., a university endowment. The center is currently funded through a line item in the state budget.

The center negotiates lease arrangements with each client. A company needing minimum services can obtain space in the 40,000 square-foot incubator for as little as $2 to $5 per square foot per year. The incubator acquires an equity interest in the firm. A new business may acquire access to the university laboratories, equipment, faculty, and the machine and electronics shops through the center. Faculty or staff in charge of equipment are encouraged to negotiate directly with center clients to make available virtually all university apparatus during nonuse periods.

The center works with business aggressively to obtain financing. Center Director Dr. Wilfred Konneker uses his considerable contacts in the venture capital and business communities to identify potential investors. The center maintains files on all types of funding sources and helps write SBIR or state R&D funding proposals. The center has raised hundreds of thousands of dollars for phase I and II of SBIR financing and more than $3 million through the state's Thomas Alva Edison program.

Universities must define the kinds of businesses they want to locate in their incubators and develop guidelines for continued tenancy in and relocation outside the incubators. The center imposes a number of selection criteria on potential clients: no retail, real estate, insurance, or consulting firms are allowed. Tenancy is limited to

three years; the university operates the incubator as an interim arrangement for start-up businesses and not as a real estate operation for going concerns. Most clients come from spinoffs of university research. A new research park is available for business relocations. Its viability depends heavily on the incubator's success in developing "home-grown" businesses.

Universities must develop faculty participation policies. One major concern of some Ohio University deans was that the incubator would siphon faculty from the university. In response, the Innovation Center promoted the use of release time, essentially encouraging faculty to work part-time. This arrangement allows entrepreneurial scientists to enjoy the benefits of faculty status while drawing part of their salary from the company. In addition, the center encouraged the university to bring in part-time adjunct professors and devise other arrangements that add diversity to the university community to benefit the faculty, students, and the center. This type of experimentation is critical to the success of incubators designed to draw extensively on university resources. Ohio University's model suggests a solution to a problem that hampers faculty participation in incubator projects at other universities: the lack of incentives for faculty to work outside their university teaching and research responsibilities.

Georgia's **Advanced Technology Development Center** (ATDC), located at the Georgia Institute of Technology, is designed to support the entrepreneurial energies of engineers whose technological sophistication often exceeds their business acumen. ATDC assists inventors with introductions to bankers, venture capitalists, accounting firms, and law firms. The state subsidizes office and lab space, and provides technical and consultation services for tenants. Six firms have left the incubator, and only one has become defunct.

Incubators are not significant job generators in the short term. By definition, incubating firms are at preproduction stages of development, cash-poor, and lean-staffed. Universities creating incubators must have the resolve, the resources, and the long-term view to produce substantial impact on its local economy. **Strong support from the top down is vital. Without the absolute commitment of the chief university official, chances for success are slim.** Turf battles and red-tape can paralyze efforts at the earliest stages.

There are caveats to this strategy. Direct university equity investment in incubated firms could jeopardize a university's tax status. According to some venture capitalists, university endowment investments in faculty-headed enterprises should be discouraged. Thorny conflicts could arise as a company develops. For example, the university may attempt to protect its investment in a new business by forcing out tenured faculty whom it perceives as weak business managers. A weeding-out process is inevitable, and universities must try to avoid "protecting" incubated firms from venture capitalists or other market forces that play important roles in realizing a product's commercial potential.

One characteristic that distinguished some of the most successful incubators is the leadership that the program's architect brings to his or her work. George Low at RPI, Wilfred Konneker at

Ohio University, and Joseph Pettit at the Georgia Institute of Technology's Advanced Technology Development Center are three outstanding examples of directors who made their universities full partners in the local economic development process.

Recommendations

University administrators should:

- contribute their institution's resources and space to incubator projects;
- strongly support the incubator concept and promote long-term university commitments;
- carefully identify program goals;
- establish criteria for admission to incubators;
- be open to experimental faculty personnel arrangements; and
- promote strong university leadership and political connections.

State officials should:

- identify resources that could be made available to establish incubator programs.

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